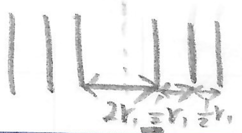


1.1

$T_{\infty 1}$ —R_{tB_1}—R_{tA_1}— $T_{\infty 2}$ $T_{\infty 1} < T_{\infty 2}$

R_{tB_1}, R_{tA_1},

$$R_{tB_1} = \frac{\ln(2r_1/\frac{3}{2}r_1)}{2\pi L k_B} = 0.046\,[K/W]$$

$$R_{tA_1} = \frac{\ln(\frac{3}{2}r_1/r_1)}{2\pi L k_A} = 0.129\,[K/W]$$

$$R_{tot_1} = 0.046 + 0.129 = 0.175\,[K/W]$$

$$Q_1 = \frac{T_{\infty 2} - T_{\infty 1}}{R_{tot_1}} = 571.429\,[W]$$

$T_{\infty 1}$ —R_{tA_2}—R_{tB_2}— $T_{\infty 2}$

R_{tA_2} R_{tB_2}

$$R_{tA_2} = \frac{\ln(2r_1/\frac{3}{2}r_1)}{2\pi L \cdot k_A} = 0.092\,[K/W]$$

$$R_{tB2} = \frac{\ln(\frac{3}{2}r_1/r_1)}{2\pi L k_B} = 0.065\,[K/W]$$

$$R_{tot2} = 0.092 + 0.065 = 0.157\,[K/W]$$

$$Q_2 = \frac{T_{\infty 2} - T_{\infty 1}}{R_{tot2}} = 636.943\,[W]$$

1.2

$$f_1(r) = \frac{r - r_1}{r_2 - r_1}$$

$f(r) = 1$ $(r_1 \le r \le r_2)$, $f(r) = 0$ $(r < r_1$ or $r > r_2)$

$$k_1 = f_1(r)k_A + (1 - f_1(r))k_B$$

$$Q_1 = \frac{2\pi L}{\ln(\frac{r_2}{r_1})} \int_{r_1}^{r_2} \frac{T_{\infty 2} - T_{\infty 1}}{\frac{1}{k_1} \frac{d}{dr}\left(\frac{1}{r}\frac{d}{dr}(rT)\right)} dr.$$

$$f_2(r) = \frac{r - r_1}{r_2 - r_1}$$

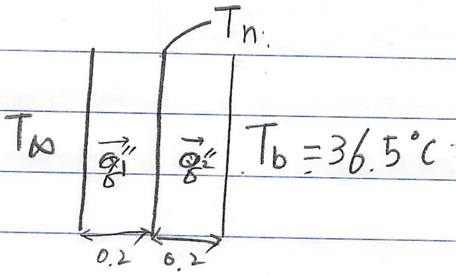
$f_2(r) = 0$ $(r_1 \le r \le r_2)$, $f_2(r) = 1$ $(r < r_1$ or $r > r_2)$

$$k_2 = f_2(r)k_A + (1 - f_2(r))k_B$$

$$Q_2 = \frac{2\pi L}{\ln(\frac{r_2}{r_1})} \int_{r_1}^{r_2} \frac{T_{\infty 2} - T_{\infty 1}}{\frac{1}{k_2} \frac{d}{dr}\left(\frac{1}{r}\frac{d}{dr}(rT)\right)} dr$$

1.3 Because of 1.1, 1.2, we can consider the position of material.
So, we can choose high conductivity material to outer.
And if there are low conductivity material, we can place that
small radius.

2.1



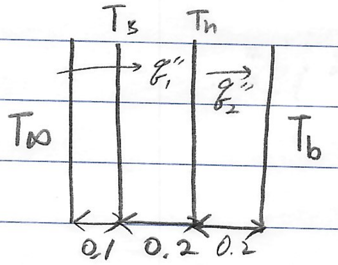
$$q_2'' = \frac{0.5}{0.2\times10^{-3}} \times (41.5 - 36.5) = 12.5\,[kW/m^2]$$

$$q_1'' = q_2''$$

$$\therefore q_1'' = \frac{T_\infty - T_n}{\frac{1}{600} + \frac{0.2\times10^{-3}}{0.5}} = \frac{T_\infty - 41.5}{2.067\times10^{-3}} = 12.5\times10^3\,[W/m^2]$$

$$\therefore T_\infty = 67.34\,[^\circ C]$$

2.2



$$q_2'' = 12.5\,[kW/m^2]$$

$$q_1'' = \frac{T_\infty - T_n}{\frac{1}{600} + \frac{0.1\times10^{-3}}{0.05} + \frac{0.2\times10^{-3}}{0.5}} = \frac{T_\infty - T_n}{4.067\times10^{-3}} = 12500[W$$

$$T_\infty = T_n + 12.5\times10^3 \times 4.067\times10^{-3} = 41.5 + 50.84 = 72.34^\circ$$

2.3 First, the reason is the geometrical factor. The skin is not enough to assume that the finger is 1D multi layer.
we can increase the hot water temperature with our artifical skin b[...] increase the thickness of artificial skin. And we can choose low heat conductivity material then we can increase hot wat[...] temperature with our artifical skin.